

Appl. No. 09/772,157
Amdt. dated July 26, 2004
Reply to Office action of Mar. 24, 2004

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Previously presented) A method for bonding a fibrous substrate surface to a second substrate surface selected from the group consisting of an elastomer substrate, an engineering plastic substrate, a metal substrate, and a fiber-reinforced composite substrate, comprising:
 - (a) providing a catalyst at the fibrous substrate surface;
 - (b) contacting the catalyst on the fibrous substrate surface with a metathesizable material so that the metathesizable material undergoes a metathesis reaction; and
 - (c) contacting the fibrous substrate surface with a second substrate surface.
2. (Previously presented) A method according to claim 1 wherein the fibrous substrate comprises a material selected from the group consisting of polyester, polyethylene, polypropylene, carbon, polyamide nylon and aramid polyamide.
3. (Original) A method according to claim 2 wherein the second substrate surface comprises an elastomeric substrate.
4. (Original) A method according to claim 3 wherein the elastomeric substrate is selected from the group consisting of natural rubber, polychloroprene, polybutadiene, polyisoprene, styrene-butadiene copolymer rubber, acrylonitrile-butadiene copolymer rubber, ethylene-propylene copolymer rubber, ethylene-propylene-diene terpolymer rubber, butyl rubber, brominated butyl rubber, alkylated chlorosulfonated polyethylene rubber, hydrogenated nitrile rubber, poly(n-butyl acrylate), thermoplastic elastomer and mixtures thereof.

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5. (Original) A method according to claim 3 wherein the elastomeric substrate is natural rubber or ethylene-propylene-diene terpolymer rubber.

6. (Previously presented) A method according to claim 1 wherein step (a) comprises soaking the fibrous substrate in a catalyst solution in a carrier, removing the carrier, and step (b) comprises dipping the catalyst-soaked fibrous substrate into a metathesizable material and allowing polymerization.

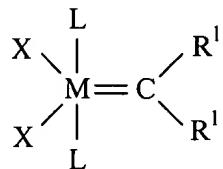
7. (Currently amended) A method according to claim 1 wherein step (c) comprises placing the fibrous substrate between two layers of second substrate surface in a mold and curing the second substrate surface with heat and pressure.

8. (Original) A method according to claim 1 wherein the catalyst is dissolved or mixed into a liquid carrier fluid.

9. (Previously presented) A method according to claim 1 wherein the catalyst is included as a component of the fibrous substrate.

10. (Original) A method according to claim 1 wherein the catalyst is selected from at least one of a rhenium compound, ruthenium compound, osmium compound, molybdenum compound, tungsten compound, titanium compound, niobium compound, iridium compound and MgCl₂.

11. (Original) A method according to claim 10 wherein the catalyst has a structure represented by



wherein M is Os, Ru or Ir; each R¹ is the same or different and is H, alkenyl, alkynyl, alkyl, aryl, alkaryl, aralkyl, carboxylate, alkoxy, allenylidenyl, indenyl, alkylalkenylcarboxy, alkenylalkoxy, alkenylaryl, alkynylalkoxy, aryloxy,

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alkoxycarbonyl, alkylthio, alkylsulfonyl, alkylsulfinyl, amino or amido; X is the same or different and is either an anionic or a neutral ligand group; and L is the same or different and is a neutral electron donor group.

12. (Original) A method according to claim 11 wherein X is Cl, Br, I, F, CN, SCN, N₃, O-alkyl or O-aryl; L is a heterocyclic ring or Q(R²)_a wherein Q is P, As, Sb or N; R² is H, cycloalkyl, alkyl, aryl, alkoxy, arylate, amino, alkylamino, arylamino, amido or a heterocyclic ring; and a is 1, 2 or 3; M is Ru; and R¹ is H, phenyl, -CH=C(phenyl)₂, -CH=C(CH₃)₂ or -C(CH₃)₂(phenyl).

13. (Original) A method according to claim 10 wherein the catalyst is a phosphine-substituted, an imidazolylidene-substituted, or a dihydroimidazolylidene-substituted ruthenium carbene.

14. (Original) A method according to claim 13 wherein the catalyst is bis(tricyclohexylphosphine)benzylidene ruthenium (IV) dichloride, tricyclohexylphosphine[1,3-bis(2,4,6-trimethylphenyl)-4,5-dihydroimidazol-2-ylidene][benzylidene]ruthenium (IV) dichloride, or tricyclohexylphosphine[1,3-bis(2,3,6-trimethylphenyl)-4,5-imidazol-2-ylidene][benzylidene]ruthenium (IV) dichloride.

15. (Original) A method according to claim 1 wherein the catalyst is stable in the presence of moisture and oxygen and can initiate polymerization of the metathesizable material upon contact at room temperature.

16. (Original) A method according to claim 1 wherein the metathesizable material is selected from ethene, α -alkene, acyclic alkene, acyclic diene, acetylene, cyclic alkene, cyclic polyene and mixtures thereof.

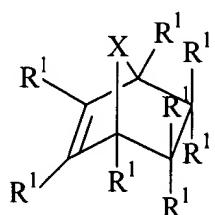
17. (Previously presented) A method according to claim 16 wherein the metathesizable material comprises a cycloolefin cyclic alkene.

18. (Original) A method according to claim 17 wherein the metathesizable material is a monomer or oligomer selected from norbornene, cycloalkene,

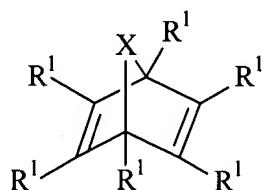
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cycloalkadiene, cycloalkatriene, cycloalkatetraene, aromatic-containing cycloolefin and mixtures thereof.

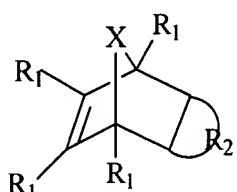
19. (Original) A method according to claim 18 wherein the metathesizable material has a structure represented by



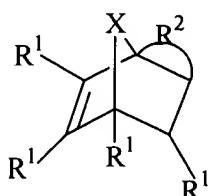
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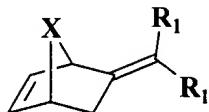


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wherein X is CH₂, CHR³, C(R³)₂, O, S, N-R³, P-R³, O=P-R³, Si(R³)₂, B-R³ or As-R³; each R¹ is independently H, CH₂, alkyl, alkenyl, cycloalkyl, cycloalkenyl, aryl, alkaryl, aralkyl, halogen, halogenated alkyl, halogenated alkenyl, alkoxy, oxyalkyl, carboxyl, carbonyl, amido, (meth)acrylate-containing group, anhydride-containing group, thioalkoxy, sulfoxide, nitro, hydroxy, keto, carbamato, sulfonyl, sulfinyl, carboxylate, silanyl, cyano or imido; R² is a fused aromatic, aliphatic or heterocyclic or polycyclic ring; and R³ is alkyl, alkenyl, cycloalkyl, cycloalkenyl, aryl, alkaryl, aralkyl or alkoxy..

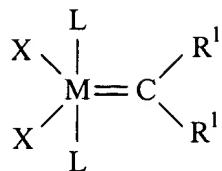
20. (Original) A method according to claim 17 wherein the metathesizable material comprises ethylenenorbornene monomer or oligomer, dicyclopentadiene or bicyclo[2.2.1]hept-5-en-2-yl-trichlorosilane.

21. (Original) A method for bonding a fibrous substrate to an elastomeric substrate comprising:

- (a) applying a catalyst on the fibrous substrate;
- (b) contacting the catalyst on the fibrous substrate with a metathesizable material so that the metathesizable material undergoes a metathesis reaction;
- (c) contacting the fibrous substrate with the elastomeric substrate to form a composite material; and
- (d) curing said composite material.

22. (Original) A method according to claim 21 wherein the catalyst has a structure represented by

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wherein M is Os, Ru or Ir; each R¹ is the same or different and is H, alkenyl, alkynyl, alkyl, aryl, alkaryl, aralkyl, carboxylate, alkoxy, allenylidanyl, indenyl, alkylalkenylcarboxy, alkenylalkoxy, alkenylaryl, alkynylalkoxy, aryloxy, alkoxycarbonyl, alkylthio, alkylsulfonyl, alkylsulfinyl, amino or amido; X is the same or different and is either an anionic or a neutral ligand group; and L is the same or different and is a neutral electron donor group.

23. (Original) A method according to claim 22 wherein X is Cl, Br, I, F, CN, SCN, N₃, O-alkyl or O-aryl; L is a heterocyclic ring or Q(R²)_a wherein Q is P, As, Sb or N; R² is H, cycloalkyl, alkyl, aryl, alkoxy, arylate, amino, alkylamino, arylamino, amido or a heterocyclic ring; and a is 1, 2 or 3; M is Ru; and R¹ is H, phenyl, -CH=C(phenyl)₂, -CH=C(CH₃)₂ or -C(CH₃)₂(phenyl).

24. (Original) A method according to claim 21 wherein the catalyst is a phosphine-substituted, an imidazolylidene-substituted, or a dihydroimidazolylidene-substituted ruthenium carbene.

25. (Original) A method according to claim 24 wherein the catalyst is bis(tricyclohexylphosphine)benzylidene ruthenium (IV) dichloride, tricyclohexylphosphine[1,3-bis(2,4,6-trimethylphenyl)-4,5-dihydroimidazol-2-ylidene][benzylidene]ruthenium (IV) dichloride, or tricyclohexylphosphine[1,3-bis(2,3,6-trimethylphenyl)-4,5-imidazol-2-ylidene][benzylidene]ruthenium (IV) dichloride.

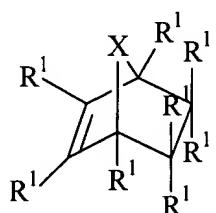
26. (Original) A method according to claim 21 wherein the metathesizable material comprises a cycloolefin.

27. (Original) A method according to claim 26 wherein the metathesizable material is a monomer or oligomer selected from norbornene, cycloalkene, cycloalkadiene, cycloalkatriene, cycloalkatetraene, aromatic-containing

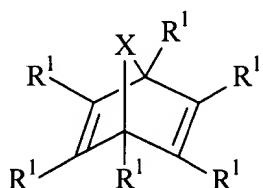
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cycloolefin and mixtures thereof.

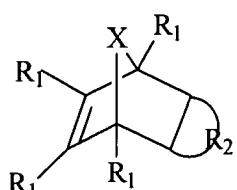
28. (Original) A method according to claim 27 wherein the metathesizable material comprises a norbornene having a structure represented by



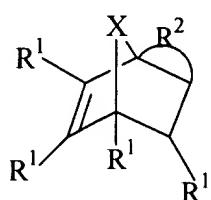
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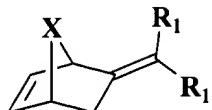
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or



wherein X is CH₂, CHR³, C(R³)₂, O, S, N-R³, P-R³, O=P-R³, Si(R³)₂, B-R³ or As-R³; each R¹ is independently H, CH₂, alkyl, alkenyl, cycloalkyl, cycloalkenyl, aryl, alkaryl, aralkyl, halogen, halogenated alkyl, halogenated alkenyl, alkoxy, oxyalkyl, carboxyl, carbonyl, amido, (meth)acrylate-containing group, anhydride-containing group, thioalkoxy, sulfoxide, nitro, hydroxy, keto, carbamato, sulfonyl, sulfinyl, carboxylate, silanyl, cyano or imido; R² is a fused aromatic, aliphatic or heterocyclic or polycyclic ring; and R³ is alkyl, alkenyl, cycloalkyl, cycloalkenyl, aryl, alkaryl, aralkyl or alkoxy.

29. (Original) A method according to claim 26 wherein the metathesizable material comprises ethylenenorbornene monomer or oligomer, dicyclopentadiene or bicyclo[2.2.1]hept-5-en-2-yl-trichlorosilane.

30. (Currently amended) A method according to claim 21 wherein the fibrous substrate is selected from the group consisting of polyester, nylon or polyamide polyethylene, polypropylene, carbon, polyamide nylon and aramid polyamide.

31. (Original) A method according to claim 30 wherein the second substrate surface is selected from the group consisting of natural rubber, polychloroprene, polybutadiene, polyisoprene, styrene-butadiene copolymer rubber, acrylonitrile-butadiene copolymer rubber, ethylene-propylene copolymer rubber, ethylene-propylene-diene terpolymer rubber, butyl rubber, brominated butyl rubber, alkylated chlorosulfonated polyethylene rubber, hydrogenated nitrile rubber, silicone rubber, fluorosilicone rubber, poly(n-butyl acrylate), thermoplastic elastomer and mixtures thereof.

32. (Original) A method according to claim 31 wherein the elastomeric substrate is natural rubber or ethylene-propylene-diene terpolymer rubber.

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33. (Original) A method according to claim 21 wherein steps (a) and (b) take place at room temperature.

34 – 48 (Canceled)

49. (Previously presented) The method according to claim 21 wherein said fibrous substrate is a reinforcing cord and said second substrate is an elastomer flowed through the reinforcing cord and cured to form a tire, belt or hose.

50. (Previously presented) The method according to claim 1 wherein said fibrous substrate is a reinforcing cord and said second substrate is a post-vulcanized or cured elastomer.